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Source / sink dynamics & Dispersal
Annotated bibliography

The movements of organisms, the temporal shifting of environmental variables and the interactions of species will determine the occourance of plants and animals in a landscape. The following is a brief review of some current litterature in which authors attempt to explain patterns in dispersal and source-sink dynamics within the context of metapopulation dynamics.

Amarasekare, P.; Nisbet, R.M. 2001. Spatial heterogeneity, source-sink dynamics, and the local coexistence of competing species. The American Naturalist 158(6):572-584

A mathematical analysis of the local co-existence of competing species. The authors do a thorough job of describing the possible outcomes of local competition among a "superior", and an "inferior", competitor. Possible outcomes are influenced by the relative effectiveness of each competitor in terms of their ability to colonize new "habitat", as well as to find refuge within existing habitat. The paper addresses the ideas of "source" and "sink" populations and the occurrence of local extinction. The mathematical models were developed with host-parasite relationships in mind and the paper includes discussion of several insect studies.

Bowman, J.; Cappuccino, N.; Fahrig, L. 2002. Patch size and population density: Effect of immigration behavior. Conservation Ecology 6(1):9

The authors challenge the idea that larger habitat patches have higher population densities and consider the implications of immigration behaviors including ground level dispersal and aerial (&planktonic) flyers/drifters. They assert that only a minority of behaviors result in positive correlation between patch size and population density.

Johnson, D.M 2004. Source-sink dynamics in a temporally heterogeneous environment. Ecology 85(7):2037-2045

By studying a herbivorous neotropical rolled-leaf beetle, (Cephaloeia fenestrata) Johnson demonstrates the temporal heterogeneity in the source-sink demographics of the species. Using "monte-carlo", type computer simulations, he examines the effects of flood events of various frequencies on the source-sink dynamics of a population of beetles.

Pulliam, H.R. 1988 Sources, sinks, and population regulation. The American Naturalist 132(5):652-661

In this paper, Pulliam develops the mathematic basis for the classic ideas of source and sink populations and points to habitat selection and "niche" (Joseph Grinnell) theory as the means by which "sink" populations become evolutionarily stable.

Sutherland, G.D.; Harestad, A.S.; Price, K.P.; Lertzman, K.P. 2000. Scaling of natal dispersal distances in terrestrial birds and mammals. Conservation Ecology 4(1):16

The authors looked at data from 77 studies of birds and 68 studies of mammal to identify trends in median dispersal distance based on factors like body mass; diet type and taxonomic relatedness. Body mass and diet type were found to be significant predictors of dispersal distance. The authors fit an empirical model based on the negative exponential distribution to the data for birds and mammals. They claim that their empirical models offer good predictive ability for dispersal distances but caution that the models are best used to identify species that may be potentially impacted by management decisions. This paper highlights the importance of the rare long distance disperser and addresses the issue of matrix quality as it relates to management issues.

Thomas, C.D.; Kunin, W.E. 1999. The spatial structure of populations. Journal of Animal Ecology.

The authors provide a model of the structure of populations based on the idea of a "Compensation Axis" in the "demographic space" (a three dimensional space), between the internal and external processes of populations. The three dimensional demographic space sits between the birth and death axis on one hand and the immigration/emigration axis on the other. The authors trumpeted their models virtues for its ability to describe a population on any scale and its ability to transcend the ideas of "source", "sink", "pseudosink" and "classical" population structure.

Tischendorf, L.; Bender, D.J.; Farig, L. 2003. Evaluation of patch isolation metrics in mosaic landscapes for specialist vs. generalist dispersers. Landscape Ecology 18:41-50.

The dispersal/migration of two generalized "disperser-types", were modeled in a computer simulation. Virtual landscapes were composed of "habitat"; "hospitable matrix", and "inhospitable matrix". Seven metrics that describe the virtual landscape in each simulation were tested for their ability to predict dispersal. Area based metrics performed best at low landscape complexity but all metrics performed unpredictably when landscape structure contained more than 30% habitat. The results indicated that the patterns of specialist dispersers are more difficult to predict, presumable because they use the matrix in more subtle ways than generalists. In this paper, the matrix was treated as heterogeneous and not totally devoid of any value to dispersers as in previous mathematical modeling attempts.

Vandermeer, J.V.; Carvajal, R. 2001. Metapopulation dynamics and the quality of the matrix. The American Naturalist 158(3):211-220

A balanced review of the literature surrounding the way the idea of the "matrix" has been treated thus far (in terms of mathematical modeling). The authors drive home the point that the matrix is not homogeneous and its quality not only affects it classification but the stability of its classification through time using examples from some interesting recent literature.

Wiegand, T.; Revilla, E.; Moloney, K.A. 2003. Effects of habitat loss and fragmentation on population dynamics. Conservation Biology 19(1):108-121

In this recent study, the authors modeled the survivability of a population of European Brown Bears, (Ursus arctos) in a computer simulation based on a spatially explicit population model developed by Wiegand et al. 1999. They find that their model is quite sensitive to changes in the quality or local heterogeneity of the matrix.